Space Weather Technical Forecast

Issued on Friday, 03 May 2024 at 01:42 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-flares expected with a slight chance of X-flares through the period. Possible G1/Minor storms early today and again later in the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is at Moderate levels, due to a M.2 flare at 02/2057 UTC from AR3664. There are currently eight sunspot regions on the visible disc. Of these AR3663 and AR3664 are the largest and most complex, both with delta spots. AR3663 continues to develop, whilst AR3664 is now the most active region on the disc.

Two narrow CME's emitted by AR3663 on the 2nd May are not expected to be Earth directed. AR3664 has produced several CME's over the past 24 hours. Although analysis is awaited, these are currently not through tot be Earth directed either.

Solar Wind / Geomagnetic Activity: Solar winds observed by ACE at L1 were at background levels, between 340-370 km/s, until an unexpected CME arrived at 02/1310 UTC. Then the solar wind increased, eventually peaking at 02/1802 UTC. Density was mostly average, but with the CME arrival increased to peak at 28 ppcc at 02/1522 UTC. The Interplanetary Magnetic Field, Bt,started at moderate levels, then increased to reach 21nT at 02/1421 UTC. The north-south component, Bz, was initially positive period, but became mostly negative from 02/0400 UTC, with a decline to -12nT at 02/0925 UTC due to the arrival of a weak glancing CME. Then with the arrival of the later CME the Bz decreased to reach -19 nT at 02/1354 UTC. Phi angle was predominately positive (away from the Sun) until late morning, then become mainly negative (towards the Sun). The resultant Geomagnetic activity was Quiet (Kp 0-2) at first, then increased to reach G3/Strong (Kp 7) geomagnetic storm levels between 02/1500-2100 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) observed at GOES18 was at background levels. High energy electron flux (greater than 2MeV) observed at GOES16 remained at background to moderate levels. The associated 24-hour fluence was well below the Active threshold. Observed fluence at 03/0001UTC was 7.49e6 integrated pfu, with a steady trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate solar activity is expected to continue with further M-flares expected and a slight chance of isolated X-flares, principally from AR3664, although AR3654 could still contribute today before it rotates far behind the west limb. Also, from tomorrow onwards new or returning regions are likely to arrive onto the visible disc and will be potential sources of further significant flares.

Solar Wind / Geomagnetic Activity: The solar wind environment is still currently influence by residual CME affects, which are expected to gradually diminish through today. However, there is

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a chance of a glancing blow from a CME that left the Sun on the 29th, arriving sometime today (3rd). A more notable CME that left the Sun around 01/0600 UTC from the southwest disc is now expected to give a glancing blow either late tomorrow (4th) or more likely early on day 3 (5th). Coronal hole influence may increase wind speeds through today or tomorrow, possibly reaching elevated levels, and then persist through day 3 (5th May), before probably declining through day 4 (6th).

Geomagnetic activity is expected to be Unsettled to Active (Kp 3-4) for much of the forecast period, due to residual CME influence, new CME arrivals combined with a HSS. There is also a chance of G1/Minor (Kp 5) geomagnetic storm intervals, especially at first today and again late tomorrow into day 3 (5th). Later day 4 (6th) geomagnetic activity may decline to Quiet to Unsettled levels.

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background levels through this period. There is a chance for an S1/Minor Storm or greater event, should any proton-rich flares occur, mainly from AR3654 before the region rotates onto the far side through today.
High energy electron flux is expected to remain at background to moderate levels, with associated fluence expected to remain below the Active (1e8 integrated pfu) threshold throughout.

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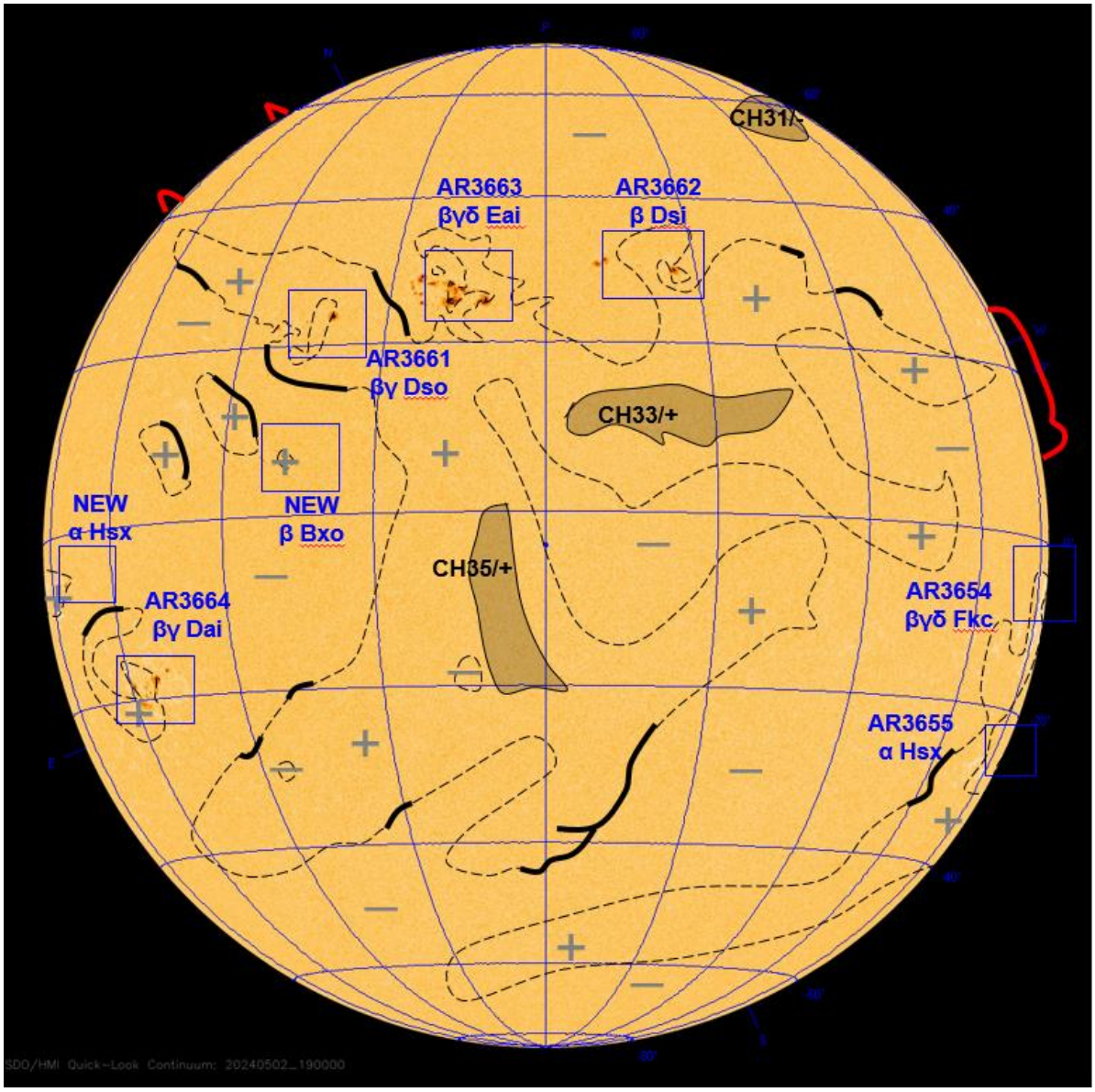
Figure 1. Solar Analysis Valid 02/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

An unexpected CME arrived at 02/1310 UTC, and the solar wind environment is still currently under the residual effects, which are expected to gradually diminish through today. However, there is a chance of a glancing blow from a CME that left the Sun on the 29th, arriving sometime today (3rd). A more notable CME that left the Sun around 01/0600 UTC from the southwest disc is now expected to give a glancing blow either late tomorrow (4th) or more likely early on day 3 (5th).

A HSS from CH33/+ may increase wind speeds through today or tomorrow, possibly reaching elevated levels, and then persist through day 3 (5th May), before probably declining through day 4 (6th). CH33 is a slightly larger and more defined feature on this rotation, and therefore persistence forecasting is unlikely to help.

Geomagnetic activity is expected to be Unsettled to Active (Kp 3-4) for much of the forecast period, due to a combination of residual CME influence, new CME arrivals and a HSS. There is also a chance of G1/Minor (Kp 5) geomagnetic storm intervals, especially at first today and again late tomorrow into day 3 (5th). Later day 4 (6th) geomagnetic activity may decline to Quiet to Unsettled levels.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	70	50	50	30
Strong	G3	Yes	10	10	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1259	Partial	AR3654	SW	585	05/0000 UTC	Glancing blow

Figure 2: Solar wind from ACE showing CME arrival.

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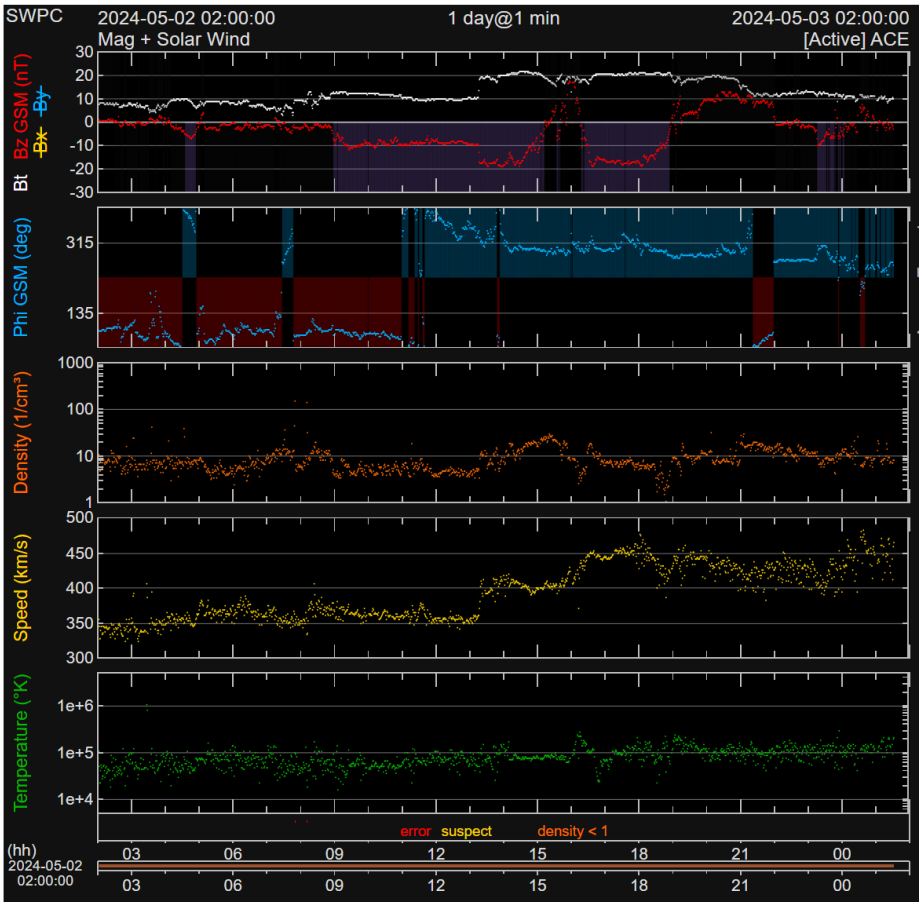
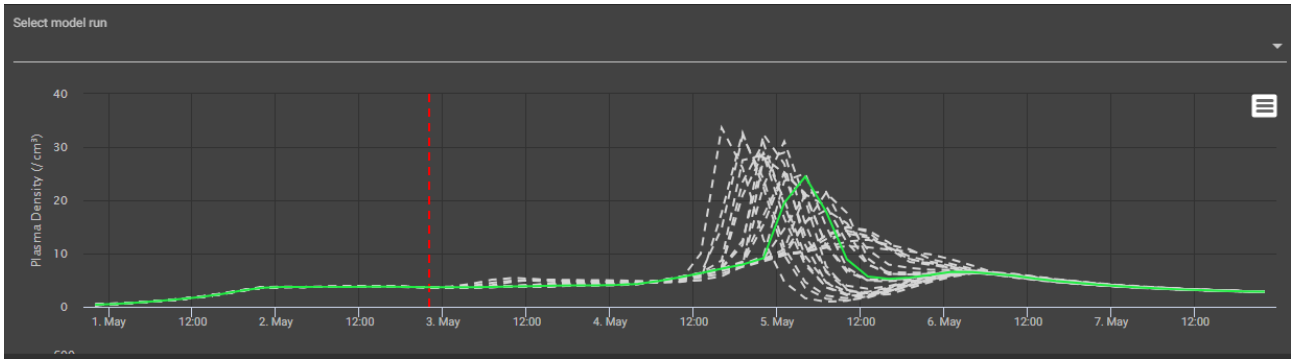


Figure 3: MOSWOC Enlil ensemble forecast.



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Met Office Space Weather Technical Forecast

Radio Blackouts - X-Ray Flares:

There are currently eight sunspot regions on the visible disc, seven of which are numbered, although AR3654 will soon rotate out of sight behind the west limb. AR3664 now replaces AR3654 as the most active region on the visible disc, having produced the largest flare of the previous 24 hours. AR3663 has a continuing delta spot, and is now classified as Eai/beta-gamma-delta. AR3661 has shown some slight decay in its intermediate spots. AR3662 has shown some consolidation in its trailing spots, but remains stable. AR3664 in the southeast has continues to show some minor growth in its intermediate portion, and produced the largest flare of the previous 24 hours. A new region has emerged in the northeast quadrant, although this appears to be a small and simple sunspot region at present. Remaining sunspot regions on the visible disc are also small and simple.
Moderate solar activity is expected to continue with further M-flares expected and a slight chance of isolated X-flares, principally from AR3664, although AR3654 could still contribute today before it rotates far behind the west limb.

There are limited signals in far-side helioseismographs for any significant oncoming regions in the coming days, but some smaller returning regions are expected and may contribute to the risk of significant flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	60	60	60
Very Active	R3 to R5 X Class	No	15	10	10	10

Solar Radiation Storms - (High Energy Protons):

High energy proton flux (greater than 10MeV) observed at GOES-18 has been at background levels and is most likely to remain that way through the period. However, there is a chance for an S1/Minor Storm or greater event today, should there be any large, proton-rich flares from AR3654. A slight chance of a S1 continues through tomorrow (4th May), despite the region rotating over the western limb.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	20	10	5	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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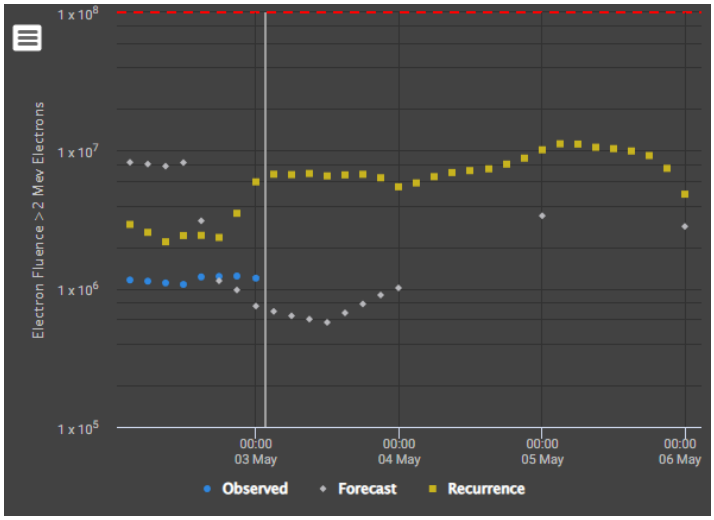
High Energy Electrons Event (≥ 2MeV):

High energy electron flux is at background levels. Combined minor CME and coronal hole influences through the period are likely to maintain the electron flux to background to moderate levels throughout the period.
Overall, the 24 hour integrated electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold, despite a gradual increasing trend, with MOSWOC REFM output a good guidance at present.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: MOSWOC REFM Model.



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